DOCUMENT RESUME

ED 233 708 IR 010 799

AUTHOR Schimmel, Barry J.
TITLE A Meta-Analysis of Feedback to Learners in Computerized and Programmed Instruction.
PUB DATE Apr 83
NOTE 17p.; Paper presented at the Annual Meeting of the American Educational Research Association (Montreal, Canada, April 11-14, 1983)
PUB TYPE Information Analyses (070) -- Viewpoints (120) -- Reports - Research/Technical (143)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS College Students; Computer Assisted Instruction; Content Analysis; *Feedback; Higher Education; High Schools; High School Students; *Programed Instructional Materials; *Prose; *Recall (Psychology); Research Methodology; *Research Problems
IDENTIFIERS *Meta Analysis

ABSTRACT

A meta-analysis was conducted of simple confirmation feedback, which informs the learner whether a response was correct or incorrect, and feedback which provides the correct answer. Following initial selection of 72 studies of computerized and printed instruction, 15 studies were identified which met the selection criteria of involving: (1) adults (either high school or university students) learning meaningful verbal material; (2) questioning about the material and immediate feedback following responses; (3) measurement of responses to all criterion test items; (4) an immediate post-test; and (5) a no-feedback control group. Results indicate that correct response or confirmation feedback is more effective than no feedback. One possible explanation for the inconsistency in feedback findings of previous research is that various characteristics of the instructional content itself (particularly prose variations such as concreteness, vividness, and vocabulary range), independent of feedback, may influence recall to an extent that overshadows any effects of feedback. An appendix presents tables showing studies used in computing effect size of both feedback types. (Author/LMM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)
☒ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED233708

A Meta-analysis of Feedback to Learners in Computerized and Programmed Instruction

Barry J. Schimmel
Teachers College,
Columbia University

Presented at the annual meeting of the
American Educational Research Association
April, 1983 -- Montreal

© 1983 by Barry J. Schimmel 16 East 98 Street, New York. New York 10029. Printed in U.S.A.

IR010799

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY
Barry J. Schimmel
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Abstract

This paper presented a meta-analysis of two types of feedback given to learners in computerized instruction: simple confirmation feedback, which informs the learner whether a response was correct or incorrect, and feedback which provides the correct answer. Learners receiving either type of feedback were found to perform .47 standard deviations above (or, on average, better than 62.8% of) learners receiving no feedback.

Previous reviews of feedback effectiveness have found inconsistent results. It was hypothesized that one source for this inconsistency was variation in the prose of instructional content independent of feedback. The prose used in different studies could vary in concreteness, vividness, vocabulary range, and other characteristics which influence recall. Questions based on the content could serve to intensify certain prose effects. The influence of prose variations may overshadow any feedback effects, and cross-study differences in feedback effectiveness may reflect differences in the types of instructional prose used in the studies.

A Meta-analysis of Feedback to Learners in Computerized and Programmed Instruction

Feedback to learners during instruction has been a puzzling variable. Intuitively, one would assume feedback (FB) is helpful in the learning process, and that view has found support (Skinner, 1968). Reviews of research on FB, however, have shown contradictory findings on FB effectiveness (Geis & Chapman, Note 1; Hyman & Tobias Note 2; Kulhavy, 1977). These reviews contained narrative research summaries and counts of reported studies. At this point the usefulness of FB is still in question. This paper will present a meta-analysis of research on FB as another way of looking at FB effectiveness. In addition, a problem will be discussed which may explain much of the inconsistency in FB findings.

FB is a broadly used term. It usually refers to information which follows, and is contingent upon, a learner's response during instruction. This paper will concentrate on two types of FB: "right/wrong" FB, which simply confirms whether or not a student's response was correct or incorrect, and FB which provides the correct answer.

Method

Locating Studies

To identify studies for this report, the databases of ERIC and Psychological Abstracts were searched by computer (Note 3). The bibliographies of resulting articles were a second source of studies.

The search was completed in January, 1983. Seventy-two articles were initially located, but this number was reduced after applying the criteria established for this study

Selection Criteria

Studies of both computerized and printed instruction showing the following characteristics were included:

1. The research involved meaningful verbal learning as described by Ausubel (1968, p.38). Studies of psychomotor tasks or paired-associate learning, for example, were eliminated.
2. The research involved adult learners.
3. FB presentation was not under student control, and FB was given after responses to all questions during instruction. Studies in which FB was presented only after certain responses were omitted.
4. FB was not available before the student responded. Pre-response FB, in which the answers are available before the student responds, seems to stretch any definition of FB. Nevertheless the answers to questions have frequently been made available before the student responded, particularly in early programmed instruction (PI). These answers were made available in various forms. PI frames were often heavily prompted, so that the necessary response was obvious; texts were frequently written on thin paper, through which the answer could be seen on the next page; or the answer required in one frame was printed in the very next frame, so that seeing the answer before responding was sometimes unavoidable. Consistent with Annett (1969, p.102), Anderson, Kulhavy, and Andre (1971; 1972) have demonstrated that pre-response FB is

significantly less effective than FB which follows the learner's response.

5. FB was presented immediately (< 3 seconds) after the student responded, and the criterion test of learning was given immediately after instruction ended. Studies of delayed FB and measures of delayed retention were excluded.

6. A measure of learning was reported based on all items in the criterion test. Other statistics, based on a subset of test items, may be more useful for measuring FB effects (DeKlerk & DeKlerk, 1978 Guthrie, 1971· Roper 1977) but few studies using these measures were available.

7. The study experimentally compared a group receiving FB with a group receiving no FB.

The studies which remained used three types of FB: (a) confirmation FB, (b) correct response FB; and (c) FB containing various forms of explanation, remediation, or review of the instructional content. The last category included a heterogeneous group of FB forms in which the same type of FB was used in only a few studies. Consequently, only studies from the first two FB information levels were included in the meta-analysis. In order to keep these types of FB internally consistent, treatments which contained both low and high information content were excluded. For example, FB consisting of both the correct response and remediation was omitted from this study.

In summary, this analysis included studies of adults learning meaningful verbal material. During instruction, participants were asked questions about the material and received FB immediately after each response. Learning outcomes of FB measured responses to all criterion test items and were given immediately after instruction. The studies compared a control group receiving no FB with a group receiving either confirmation FB or correct response FB.

After applying these selection criteria, fifteen studies remained. This is a relatively small pool of research for a meta-analysis. With a variable which has taken as many forms as FB, however, a focused rather than global meta-analysis was considered to have greater value.

Results

For each comparison of FB vs. no FB the influence of FB on learning was converted into an effect size (Glass, 1977). The mean effect sizes found are shown in Table 1. In each row the number of comparisons exceeds the number of studies because some studies contained multiple groups receiving that form of FB. The studies used to compute these effect sizes are listed in the Appendix.

The first section of Table 1 shows the effect sizes found for confirmation and correct response FB separately and combined. The studies used to compute these effect sizes are listed in the Appendix. The average student receiving confirmation or correct response FB performed .47 standard deviations better than the average student receiving no FB. Alternatively, a student learning with either of these FB forms would,

on the average, learn more than 68.2% of the individuals in a no-FB

Table 1

Mean Effect Sizes for Different Types of Feedback

Type of Feedback	Number of Studies	Number of Comparisons	Mean Effect Size	Standard Error
Feedback Treatment				
Correct response and confirmation feedback combined (a)	15	21	.47	.13
Confirmation feedback	5	6	.76	.05
Correct response feedback	10	15	.36	.17
Presentation Medium				
CAI (Correct response feedback)	5	8	.76	.13
Print (Correct response feedback)	5	6	-.10	.25
Learning Task				
Intellectual skills (a)	4	6	.86	.14
Verbal information (a)	11	15	.32	.15

Note. All effect sizes are based on comparisons with groups receiving no feedback.

(a)The effect sizes of feedback in studies using either correct response or confirmation feedback were averaged.

group. The next section of Table 1 shows the effects of FB in specific media. On average, a student in a CAI course receiving correct response FB performed better than 77.6% of the learners receiving no FB in the same course. In the last section of the Table studies are categorized in Gagné's (1977) terms by type of learning task. FB appeared useful for learning both intellectual skills (i.e. concepts and rules) and verbal information. Four of the fifteen studies involved learning intellectual skills: Anderson, Kulhavy, and Andre (1972), DeKlerk and DeKlerk (1978), Merrill (1970), and Roper (1977). The other studies used verbal information tasks.

Discussion

The meta-analysis shows that learning occurs more effectively with confirmation or correct response FB than with no FB. A small number of studies suggest that in CAI, correct response feedback is considerably more effective for learning than a lack of FB. It is also suggested that FB, either confirmation or correct response, is particularly effective in teaching intellectual skills, consistent with Reiser and Gagné (1982). These latter points, however, are based on small groups of studies.

Learners in all the studies summarized were either high school or university students. It is uncertain whether FB would show the same results with different types of students.

This paper will now concentrate on one possible explanation for the inconsistency in FB findings. The general point is that various characteristics of the instructional content itself, independent of FB, may influence recall to an extent that overshadows any effects of FB.

It has been demonstrated that various text characteristics influence recall of the text. Recall improves with increased vividness (Montague Carter, 1973) and concreteness (Anderson, 1974), and if a smaller rather than larger variety of words is used to express the same ideas (Kintsch, 1975). Superordinate text ideas are more likely to be remembered than subordinate information (Kintsch, 1975; Meyer, 1977). Thus (in unsurprising accordance with common sense),

different texts or parts of the same text may vary in their ease of recall. Studies using texts which differ in recall difficulty may produce inconsistent findings on FB effectiveness, even if all other aspects of the studies were equal.

The questions developed for both instruction and the criterion test may influence the effect of text variations on recall. Questions which are heavily based on particularly vivid, superordinate parts of the text will presumably be easier to answer than questions based on subordinate, less vivid parts. Studies in which questions are concentrated on abstract, subordinate passages will be more likely to result in lower recall scores. Thus, questions can be seen as a device for selecting the text components that will affect recall.

Only three of the fifteen studies (Anderson, Kulhavy, & Andre, 1971, Experiment II; Jacobs & Kulkarny, 1966; Merrill, 1970) in this meta-analysis provided any information as to how the questions used in the studies were selected or related to the instructional content. Even these three studies reported little, stating only that an item analysis or judgments about validity had been made, or that at least one question was chosen for each sub-task or concept taught. None of the studies specified the number of instructional and criterion questions corresponding to each unit of content taught. This is consistent with Anderson's (1972) critique that in much educational research little is reported about the development of criterion achievement tests.

With little information about the questions used in FB studies, it is fair to suggest that in some studies certain parts of the content are tested more heavily than others. If, due to language variations in the content, those parts are more prone to recall than other parts, those studies will show relatively high recall rates --perhaps independent of FB.

Inconsistent findings on FB effectiveness may reflect different levels of difficulty in recall. An investigation of the effects of variation in recall difficulty on FB effectiveness would be worthwhile.

Reference Notes

1. Geis, G.L. and Chapman, R. Knowledge of results and other possible reinforcers in self-instructional systems. Unpublished manuscript, 1971. (ERIC Document ED 049464).

2. Hyman,C. and Tobias, S. Feedback and prior achievement. Paper presented at the annual meeting of the Northeastern Educational Research Association, Ellenville, New York, October, 1981. (ERIC Document ED 206739).

3. The following descriptors were used in the computer search: feedback knowledge of results, review, computer-assisted instruction, and programmed instruction.

References

Annett, J. Feedback and human behaviour. Baltimore: Penguin, 1969.

Ausubel, D.P. Educational psychology, a cognitive view. New York: Holt, Rinehart, and Winston, 1968.

Anderson, R.C. Concretization and sentence learning. Journal of Educational Psychology, 1974, 66, 179-183.

Anderson, R.C., Kulhavy, R.W., and Andre, T. Feedback procedures in programmed instruction. Journal of Educational Psychology, 1971, 62, 148-156.

Anderson, R.C., Kulhavy, R.W., and Andre, T. Conditions under which feedback facilitated learning from programmed lessons. Journal of Educational Psychology, 1972, 63, 186-188.

DeKlerk, L.F.W. Jr. and DeKlerk, L. The effect of knowledge of correct results per item on verbal learning and retention. Instructional Science, 1978, 7, 347-358.

Frase, L.T. Learning from prose material: Length of passage, knowledge of results, and position of questions. Journal of Educational Psychology, 1967, 58, 266-272.

Fulmer, R.S. and Rollings, H.E. Item-by-item feedback and multiple choice test performance. Journal of Experimental Education, 1976, 44(4), 30-32.

Gagné, R.M. The conditions of learning. New York: Holt, Rinehart and Winston, 1977.

Glass, G.V. Integrating findings: The meta-analysis of research.

In L.S. Shulman (Ed.), Review of research in education. Itasca, Illinois: F.E. Peacock, 1977.

Guthrie, J.T. Feedback and sentence learning. Journal of Verbal Learning and Verbal Behavior, 1971, 10, 23-28.

Jacobs, P.I. and Kulkarny, S. A test of some assumptions underlying programmed instruction. Psychological Reports, 1966, 18, 103-110.

Kintsch, W., Kozminsky,E., Streby,W.J., McKoon, G., and Keenan, J.M. Comprehension and recall of text as a function of content variables. Journal of Verbal Learning and Verbal Behavior, 1975, 14, 196-214.

Kulhavy, R.W. Feedback in written instruction. Review of Educational Research, 1977 47, 211-232.

Kulhavy, R.W., Yekovich, F.R., and Dyer, J.W. Feedback and content review in programmed instruction. Contemporary Educational Psychology, 1979, 4, 91-98.

Kulhavy, R.W., Yekovich, F.R., and Dyer, J.W. Feedback and response confidence. Journal of Educational Psychology, 1976, 68, 522-528.

Merrill, M.D. Specific review versus repeated presentation in a programmed imaginary science. Journal of Educational Psychology, 1970, 61, 392-399.

Meyer, B.J.F. The structure of prose: Effects on learning and memory and

implications for educational practice. In R.C. Anderson, R.J.

Spiro, and W.E. Montague (Eds.), Schooling and the acquisition knowledge. Hillsdale, New Jersey:Lawrence Erlbaum Associates, 1977.

Montague, W.E. and Carter, J.F. Vividness of imagery in recalling connected discourse. Journal of Educational Psychology, 1973, 64, 72-75.

O'Day, E.F., Kulhavy, R.W., Anderson, W., and Malczynski, R.J. Programmed instruction: Techniques and trends. New York: Appleton-CenturyCrofts, 1971.

Reiser,R.A. and Gagne,R.M. Characteristics of media selection models. Review of Educational Research, 1982, 52, 499-512.

Roper, W.J. Feedback in computer-assisted instruction. Programmed Learning and Educational Technology, 1977, 14(1), 43-49.

Rothkopf, E.Z. Learning from written instructive materials: An exploration of the control of inspection behavior by test-like events. American Educational Research Journal, 1966, 3, 241-249.

Skinner, B.F. The technology of teaching. Englewood Cliffs, New Jersey: Prentice-Hall, 1968.

Sturges, P.T. Delay of informative feedback in computer-assisted testing. Journal of Educational Psychology, 1978, 70, 378-387.

Appendix

Table A

Studies Used in Computing Effect Size of Confirmation Feedback

Study	Delivery Mode	Comparison Groups[a]	Formula Used[b]	Effect Size
Frase (1967)	PI	LBA,BA,SAA v. BA,SA	(2)	.893
Kulhavy, Yekovich, & Dyer (1979)	PI	FB with text review v. no FB with text review	(1)	.709
	PI	FB without text review v. no FB without text review	(1)	.637
Merrill (1970)	CAI	Group 2 v. Group 1	(2)	.739
Roper (1977)	CAI	Group B v. Group A	(2)	.690
Rothkopf (1966)	PI	LBA,SAA,SBA v. SA,SB	(2)	.904

Note. FB=feedback, PI=programmed instruction, CAI=computer assisted instruction.

[a] This column shows the group in the particular study receiving confirmation feedback v. the group receiving no feedback.

[b] Different formulas for computing the effect size result in somewhat different values. This column indicates which of the following formulas was used: (1) $\bar{X}_e - \bar{X}_c / s_c$ (2) $t\sqrt{1/n_1 + 1/n_2}$

Table 3

Studies Used in Computing Effect Size of Correct Response Feedback

Study	Delivery Mode	Comparison Groups[a]	Formula Used[b]	Effect Size
Anderson, Kulhavy, & Andre (1971)	CAI	100% FB v. 0% FB	(2)	.520
	CAI	100% FB v. 0%	(2)	.475
Anderson, Kulhavy & Andre (1972)	CAI	100% standard v 0% standard	(2)	.296
DeKlerk & DeKlerk (1978)	CAI	Actual content, covert response v. no FB	(2)	1.141
	CAI	Actual content, overt response v. no FB	(2)	1.141
	CAI	Letter of correct alternative, overt response v. no FB	(2)	1.141
Fulmer & Rollings (1976)	PI	Machine FB v. machine no FB	(1)	.435
Hyman & Tobias (1981)	PI	FB v. no FB	(1)	- .169
Jacobs & Kulkarny (1966)	PI	High School A, FB v. no FB	(1)	-1.254
	PI	High School B, FB v. no FB	(1)	- .390
Kulhavy, Yekovich, & Dyer (1976)	PI	FB v. no FB	(1)	.571
O'Day et al. (1971)	PI	BRM-R v. BRM-F	(1)	- .068
	PI	AE v. CR	(1)	.146
Roper (1977)	CAI	Group C v. Group A	(2)	.724
Sturges (1978)	CAI	2-second delay v. no FB	(2)	.645

Note. FB=feedback, PI=programmed instruction, CAI=computer assisted instruction.

[a] This column shows the group in the particular study receiving confirmation feedback v. the group receiving no feedback.

[b] Different formulas for computing the effect size result in somewhat different values. This column indicates which of the following formulas was used: (1) $\bar{X}_e - \bar{X}_c / s_c$ (2) $t\sqrt{1/n_1 + 1/n_2}$